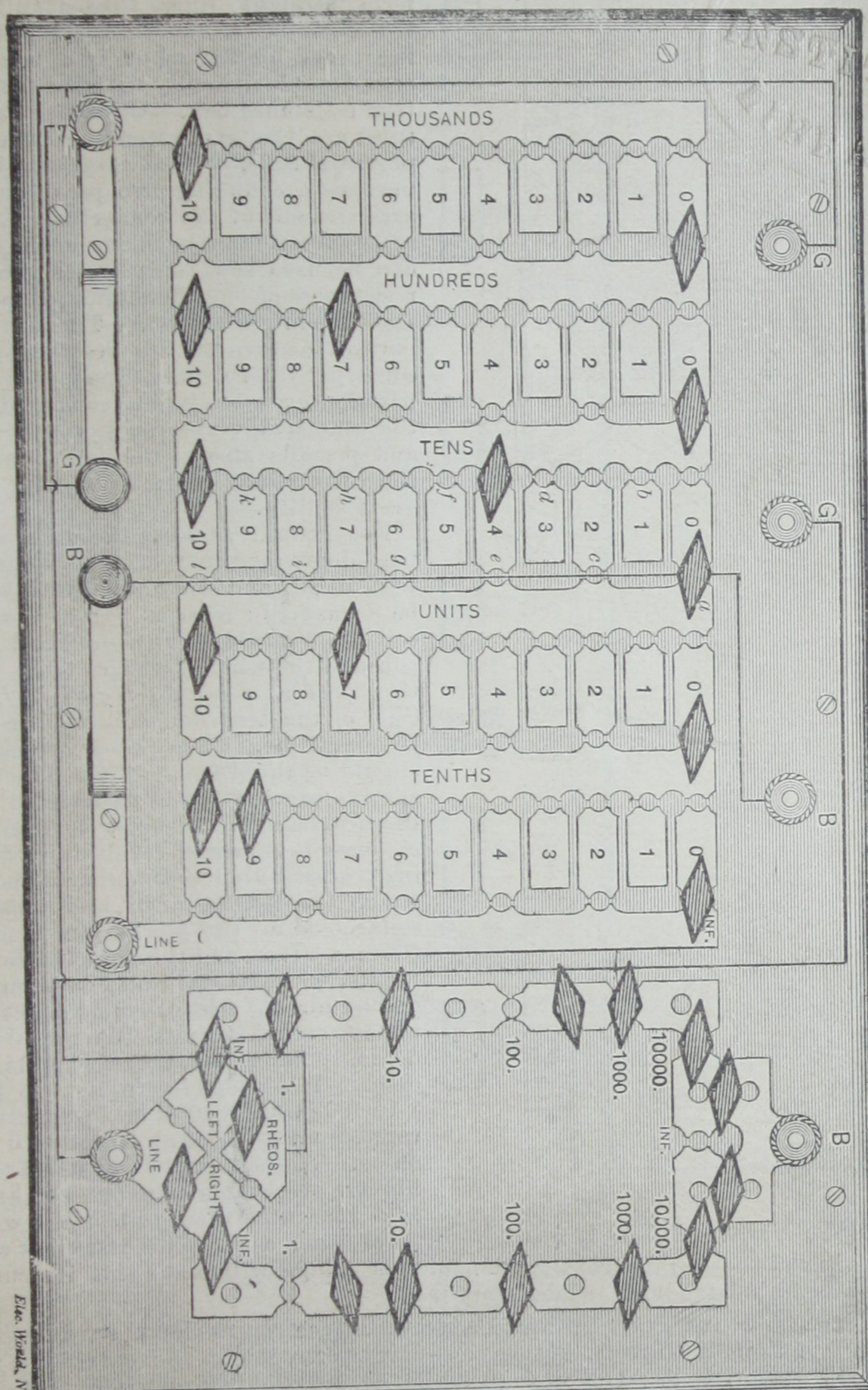
42.

NEW STANDARD ELECTRICAL INSTRUMENTS

FOR

Laboratory Use and Technical Purposes.

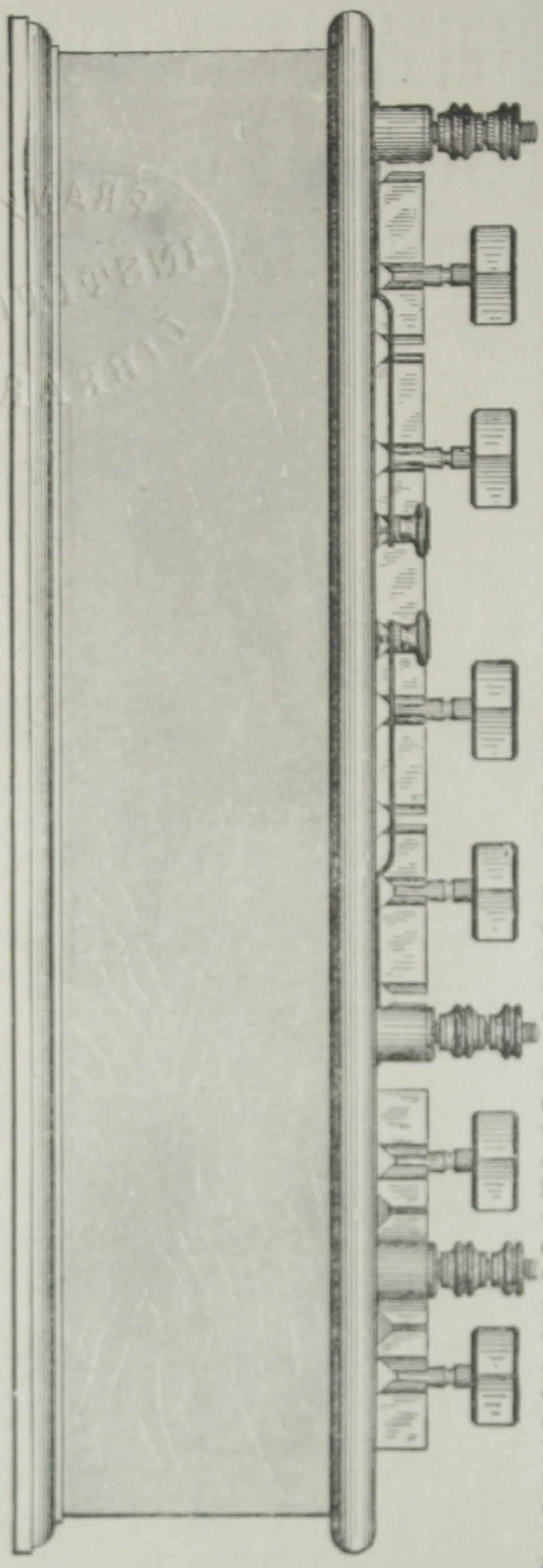
FRANKLIN INSTITUTE



No. 1. Standard Laboratory Resistance Box and Bridge. (Top View $\frac{1}{4}$ size.)

Elec. World, N. Y.

All of our new Standard Instruments as described in this circular are guaranteed to be accurate, within $\frac{1}{50}$ of 1%, and are accompanied by a certificate of Prof, William A. Anthony.

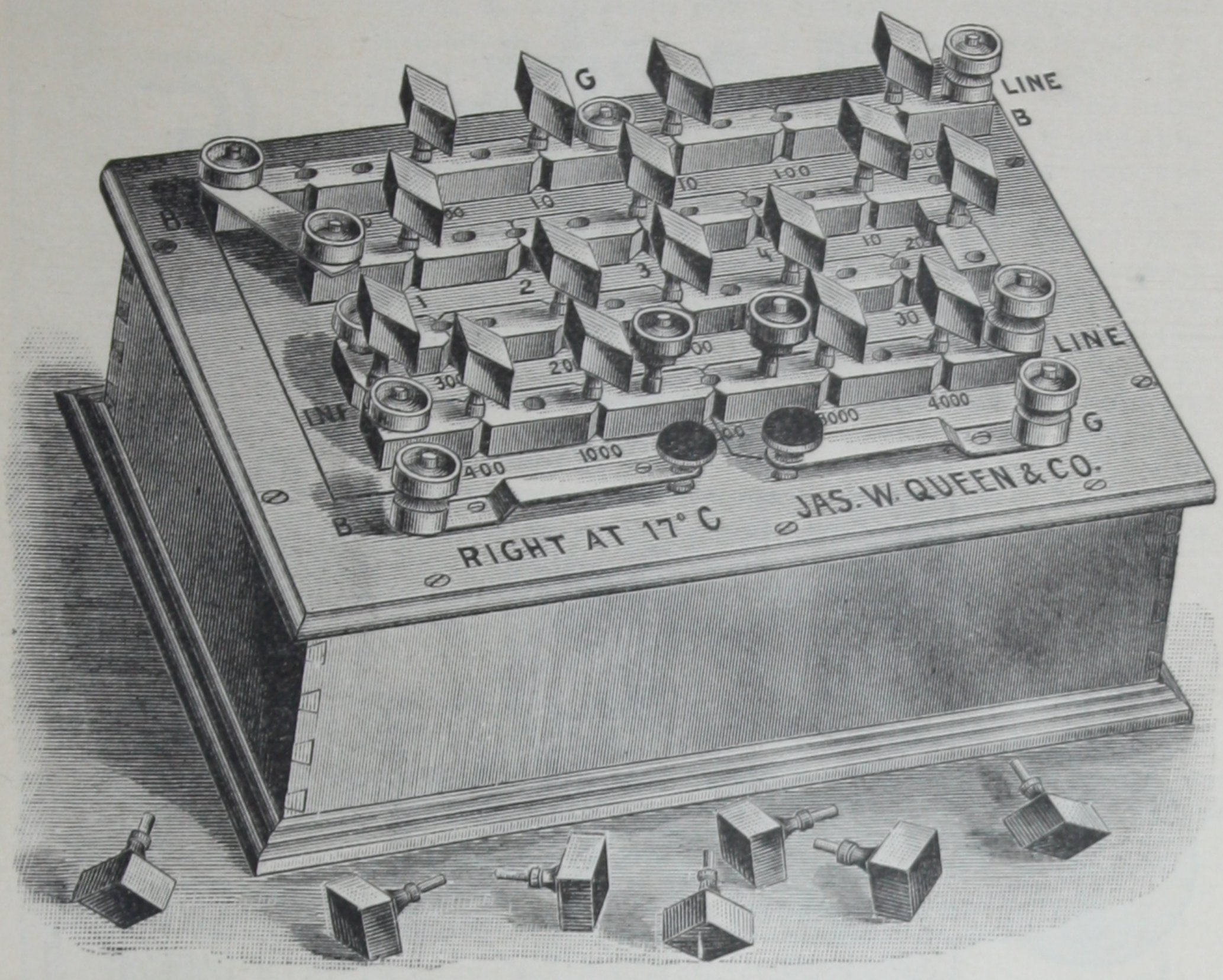


Side View of No. 1, ¼ size.

No. 1. Standard Laboratory Resistance Box and Bridge. (Design of Prof. William A. Anthony.)—The general arrangement adopted is that known as the dial pattern resistance box, but instead of a circular arrangement of the brass blocks these form straight lines, thus facilitating the cleaning of the rubber top under the brass blocks, which is a matter of considerable difficulty with the dial pattern resistance box. Other special features are the arrangement of the proportional coils, so that they can be reversed by changing two pegs, and the arrangement of the connections for the resistances so that each one of the latter can be used separately, or the several resistances of one denomination put in multiple arc in any way. This is an important feature with a resistance box constructed for standard purposes, as it permits several coils to be compared with the standard very easily and readily and permits also of the comparison of the coils among themselves with very great facility.

For instance, taking the coils of the tens denomination; it is evident that with a peg at *a* and *b* coil No. 1 would be measured; with a peg at *b* and *c* coil No. 2 would be measured and so on through the whole series of ten. Putting pegs at *a b c d e f g h i j k l*, the coils of the tens denomination are put in multiple, when their resistance should be equal to one ohm. The other special features will be understood from the illustration. In order to avoid the changes that would result from differing temperature co-efficients, the rods by which the tenths, units, and tens are connected to the blocks are made of German silver, and the same is also done for the proportional coils, one, ten and one hundred. The coils in the rheostat are 10 tenths, 10 units, 10 tens, 10 hundreds, 10 thousands, aggregating 11111.0 ohms. The bridge has in its two arms, 1-10-100-1000-10000 ohms, permitting a range from $\frac{1}{10000}$ of an ohm to 110 megohms. The coils will be adjusted to the highest precision attainable, so that we can guarantee them to be right within $\frac{1}{50}$ of 1 per cent. The first-class workmanship and the durable construction of this bridge will make this instrument a very desirable standard for laboratory use.

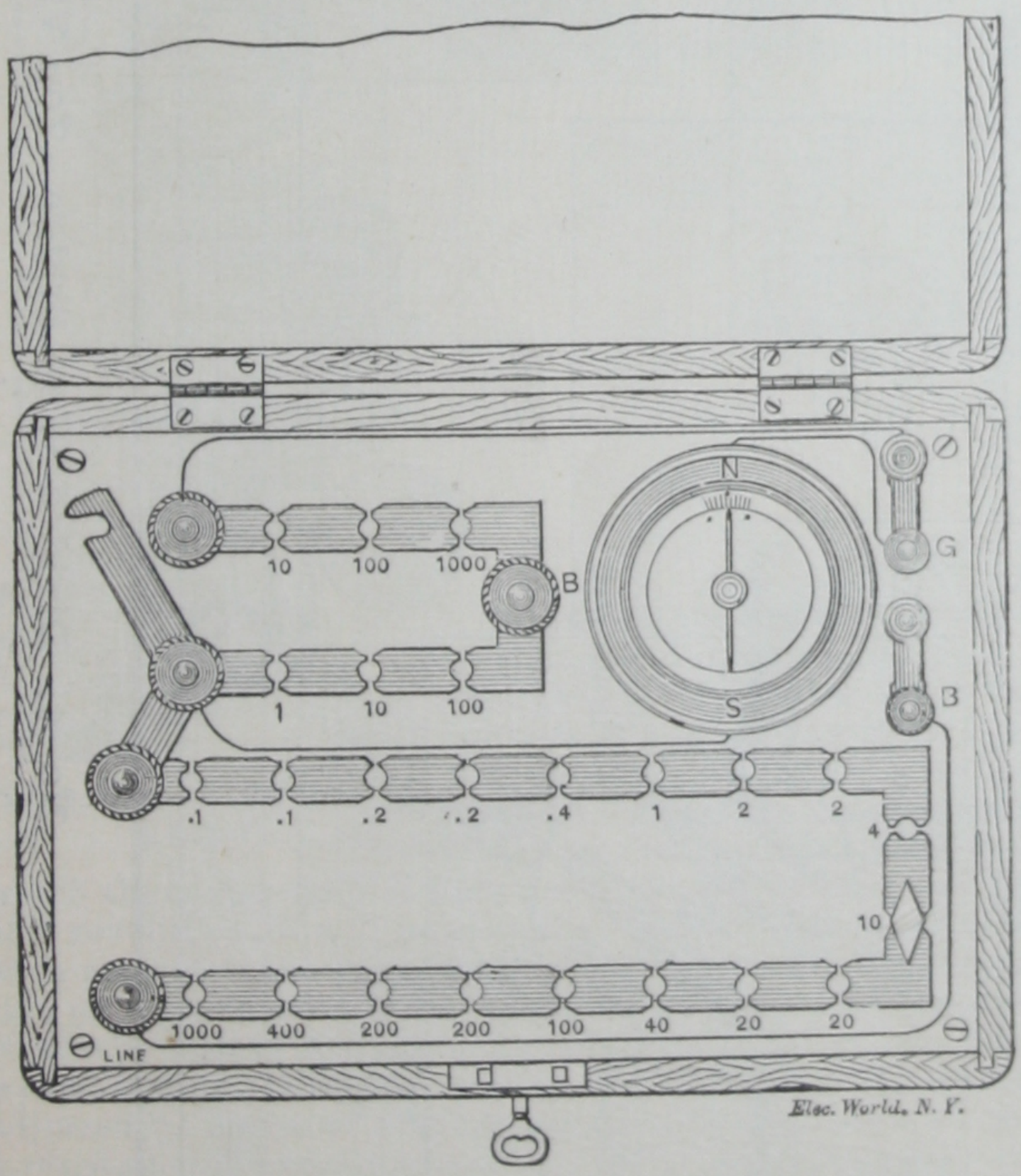
No. 2. New Post Office Pattern Resistance Box and Bridge. (Design of Prof. William A. Anthony.)—A very convenient and extremely accurate instrument. Coils: 1. 2. 3. 4. 10. 20. 30. 40. 100. 200. 300. 400. 1000. 2000. 3000. 4000 ohms.—11111 ohms in aggregate. Bridge arms, 10-100-1000 ohms respectively. Keys for galvanometer and battery. Coils guaranteed to be right within $\frac{1}{50}$ of 1 per cent. Pegs and brass blocks extra heavy. The holes in the middle of the brass blocks serve for testing or using the coils separately, eliminating contact resistances. For this purpose the two pegs, with binding post heads are used. These extra holes may also be used for receiving pegs not in use. The instrument is incased in a handsome strong box for easy transportation.



No. 2. New Post Office Pattern Resistance Box and Bridge.

No. 3. Portable Resistance Testing Set, including Resistance Box, Bridge and Galvanometer. (Design of Prof. William A. Anthony.)—The arrangement of the coils will easily be seen from the illustration. In the bridge the proportional coils are 1. 10. 100 on one side, 10. 100. 1000 on the other, and they are so arranged that either arm of the bridge may be connected to the resistance set, and a ratio of 1 to 1000 be obtained by disconnecting the brass strip shown connected in illustration, and connecting the other strip, which forms a hinged connection with the first one, with the upper binding post. The galvanometer needle is suspended by a silk fibre, and is extremely sensitive. The coils are made of wire considerably larger than is usually used in such resistance sets.

Sum of resistance in the coils is 2000 ohms. Total range 0.001. ohms to 2 megohms.



No. 3. Portable Resistance Testing Set.

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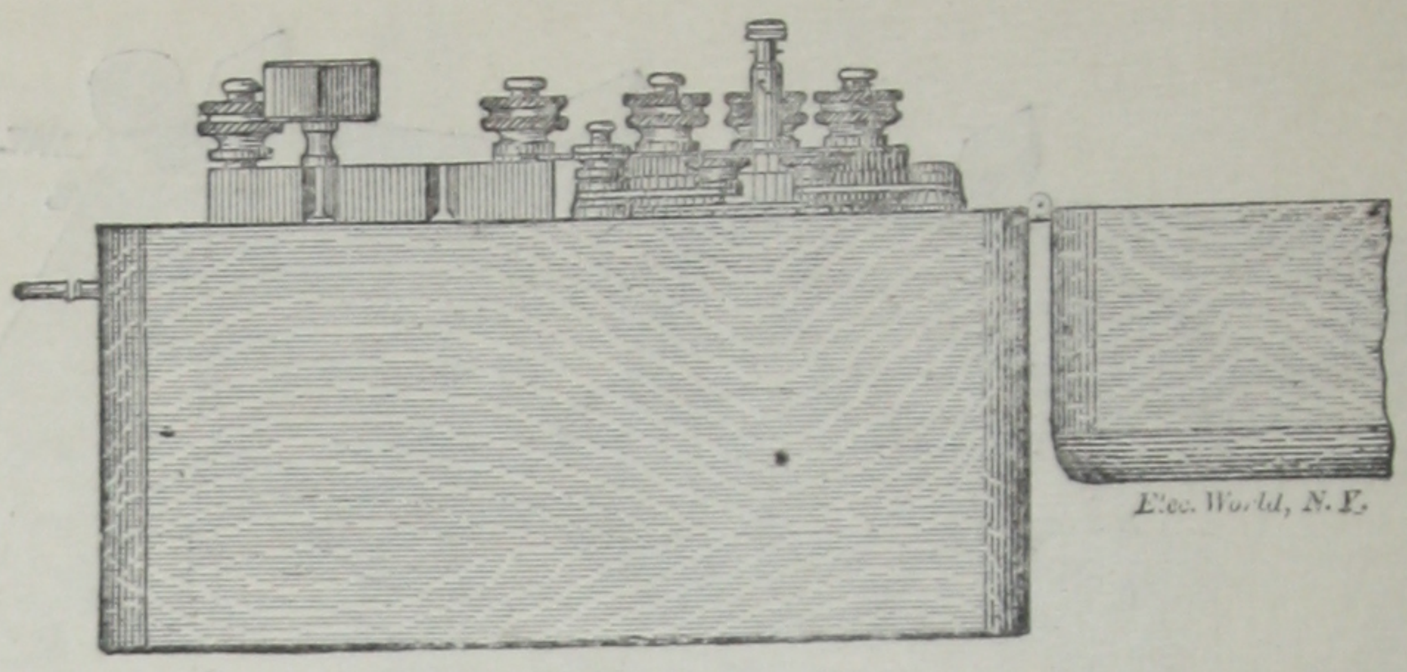
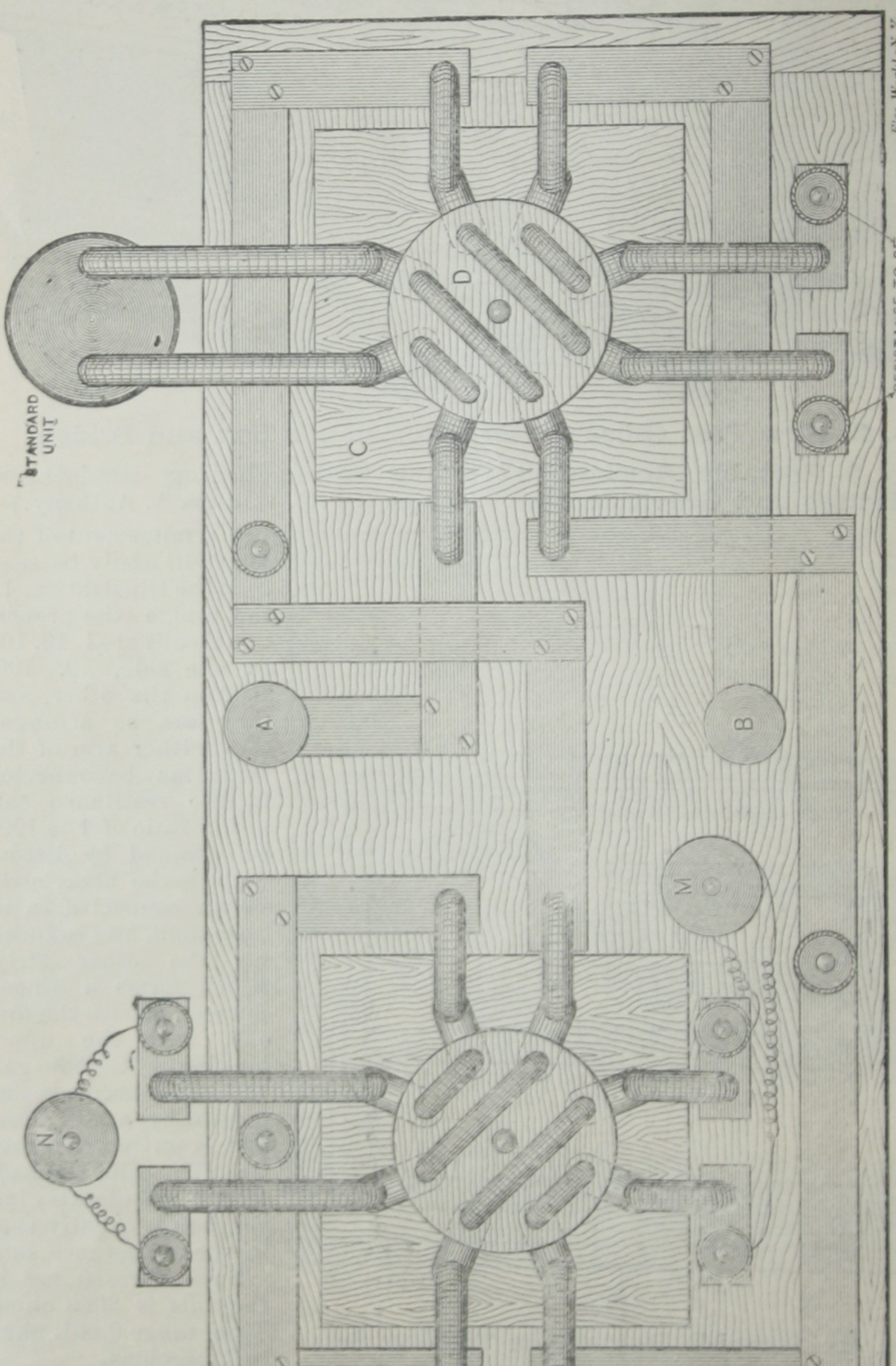
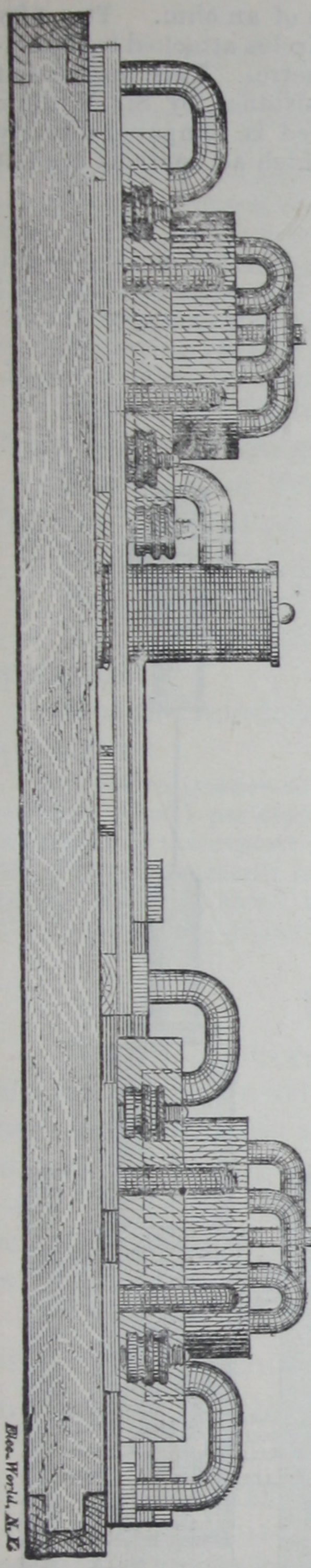


Elec. World, N. Y.

Side View of No. 3.

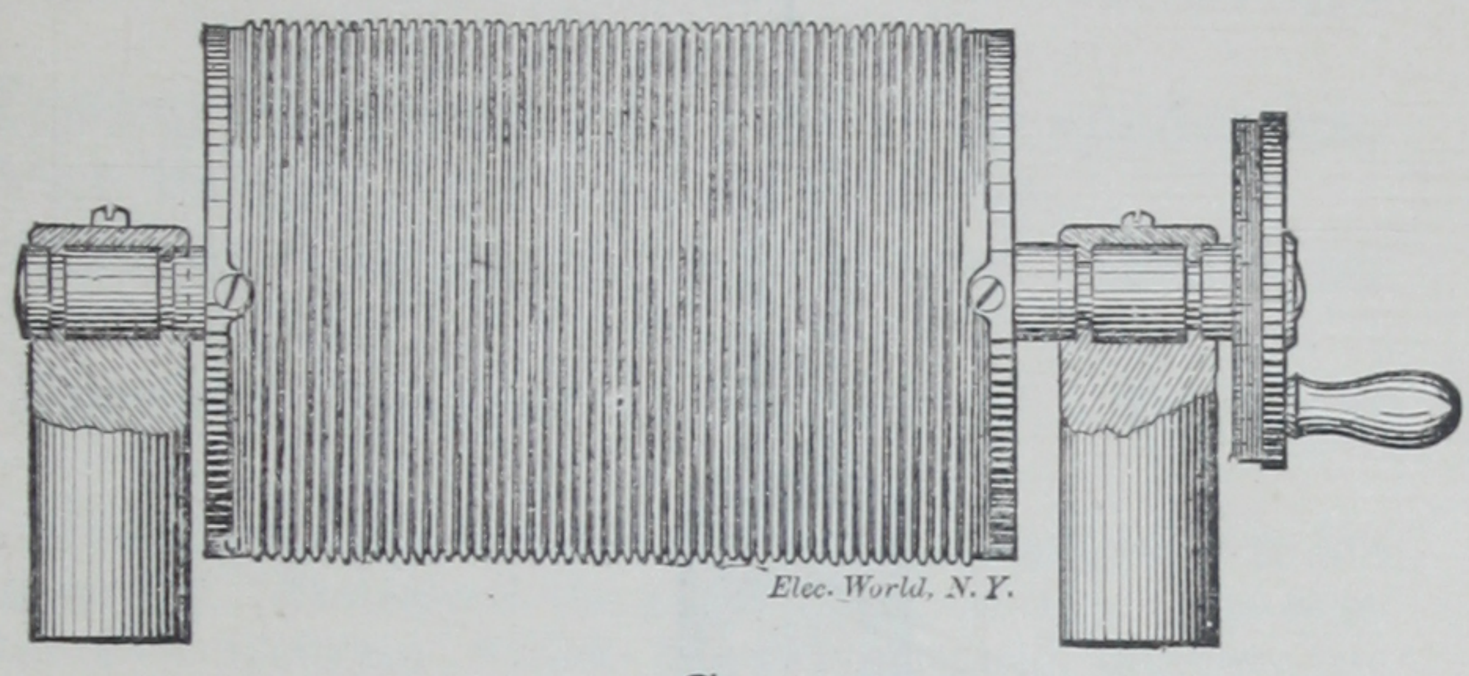


No. 4. Divided Wire Bridge. Top View $\frac{1}{4}$ size.



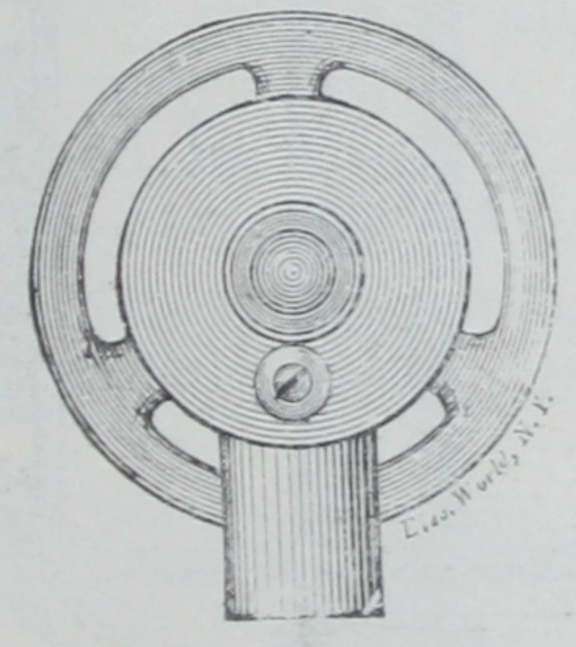
Side View of No. 4, $\frac{1}{4}$ size.

No. 4. Divided Wire Bridge. (Design of Prof. William A. Anthony.)—This very complete apparatus serves for making comparison of resistance coils with the standards while in process of construction. The wire used is long enough to have a resistance of one ohm and shows very plainly a difference of one hundred thousandth of an ohm. On account of its length it is coiled upon a cylinder of hard rubber, shown detached in a side and front view. (G and H) The illustration shows a plan view of the bridge without the cylinder which carries the wire. A and B represent the parts which support the bearings of the cylinder, and for the purpose of description it may be considered that the wire is stretched from A to B. The further mode of comparing the test with the standard is known as Carey-Foster's method. The standard and test are connected to the places designated in the figure as "standard unit," and "resistance to be



G.

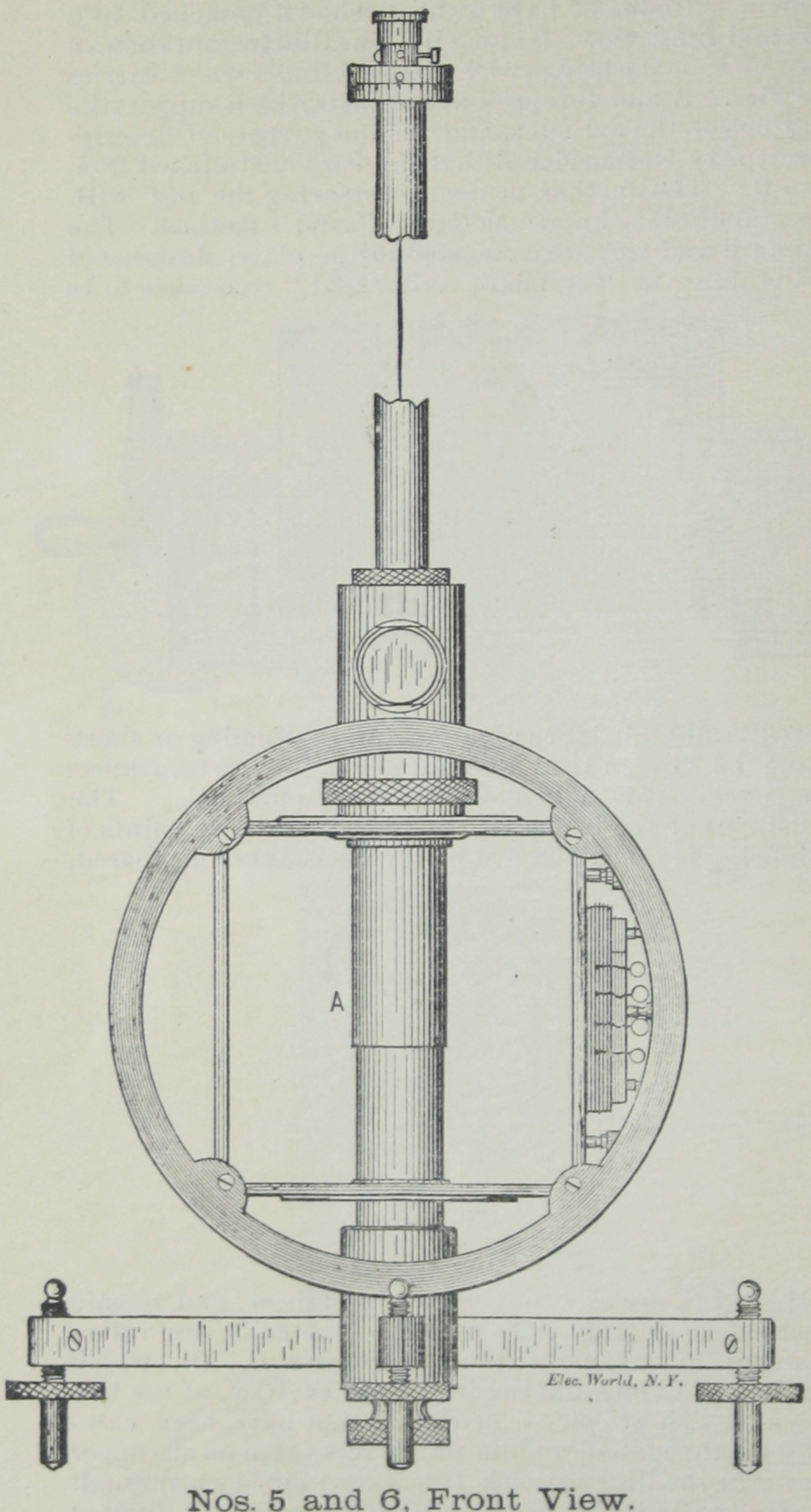
tested," and a balance obtained by lengthening or shortening the wire on the rheostat. Then the two resistances are exchanged and again balance obtained. The resistance of the bridge wire between the two points of balancing is the difference of the resistances compared.



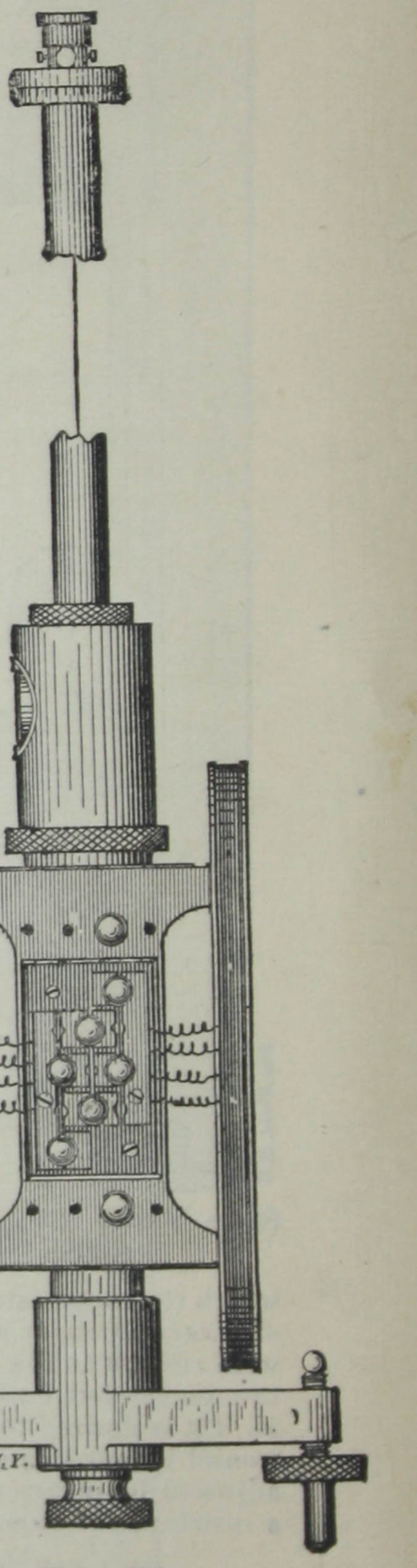
H.

M. and N. are any convenient resistances, and remain unchanged during comparison. The coils are interchanged by means of the commutator C. D., which consists of a block having in it eight cavities, at the bottom of which are pieces of copper that have been carefully amalmagated, and on which rest the rods of copper shown in the illustrations. D is a circular block through which the copper staples slide freely. On lifting the block D, and turning it a quarter of a revolution, it will be seen that the two coils to be compared are interchanged with respect to the gaps of the bridge by that one operation. A similiar commutation on the left hand of the figure serves to interchange the two resistances M. and N. if it is desired to do so for any purpose. The cylinder on which the bridge wire is wound is four inches in diameter and the wire itself makes fifty-two turns. It is adjusted by means of a shunt inside of the cylinder, so that fifty turns of it have a resistance of exactly one ohm. It is also arranged that by means of another

shunt the resistance of fifty turns may be made one tenth of an ohm. The fifty turns are divided into 10,000 equal parts by the divided circles attached to the cylinder, and each one of those parts is very nearly a millimetre. This instrument can also be used for the measurement of very small resistance, by Sir William Thomson's method, in which the resistance to be measured is compared directly with a certain length of the bridge wire by a method in which all contacts are left entirely out of account.



Nos. 5 and 6, Front View.



Nos. 5 and 6, Side View.

Nos. 5 and 6. Standard Tangent Galvanometer for Measuring Current or Potential. (Design of Prof. William A. Anthony.)—The galvanometers are constructed on the Helmholtz plan, and are so arranged that the measurement for determining the constants can be very accurately made. The winding of the galvanometer consists of four coils which may be coupled up in any way by means of the little switch board, shown at one side of the instrument. The needle is suspended by a silk fibre, which is made of very considerable length, in order that the effect of torsion might be reduced to a minimum. The needle is suspended in a cavity in the copper block A, the effect of which is to make it very nearly dead beat. The deflections are read by scale and telescope. By introducing various resistances in the circuit of the tangent galvanometer, it becomes a voltmeter for measuring potentials from fractions of a volt to 2500 volts.

No. 1. Standard Laboratory Resistance Box and Bridge. Price on application.

No. 2. New Post-Office Pattern Resistance Box and Bridge Price on application.

No. 3. Portable Testing Resistance Set. Price on application.

No. 4. Divided Wire Bridge, Price on application.

No. 5. Standard Current Tangent Galvanometer. Price on application.

No. 6. Standard Potential Tangent Galvanometer. Price on application

All the resistance coils in the above described instruments are adjusted to not less than $\frac{1}{50}$ of 1 per cent. accuracy, If desired the adjustment of the coils may be carried to the utmost attainable accuracy which however, would increase the cost of the instruments in proportion to the time spent on such additional adjustments. Thus we think we will be competent to furnish standard instruments equal in accuracy to any other made at home or abroad.

Important Notice.

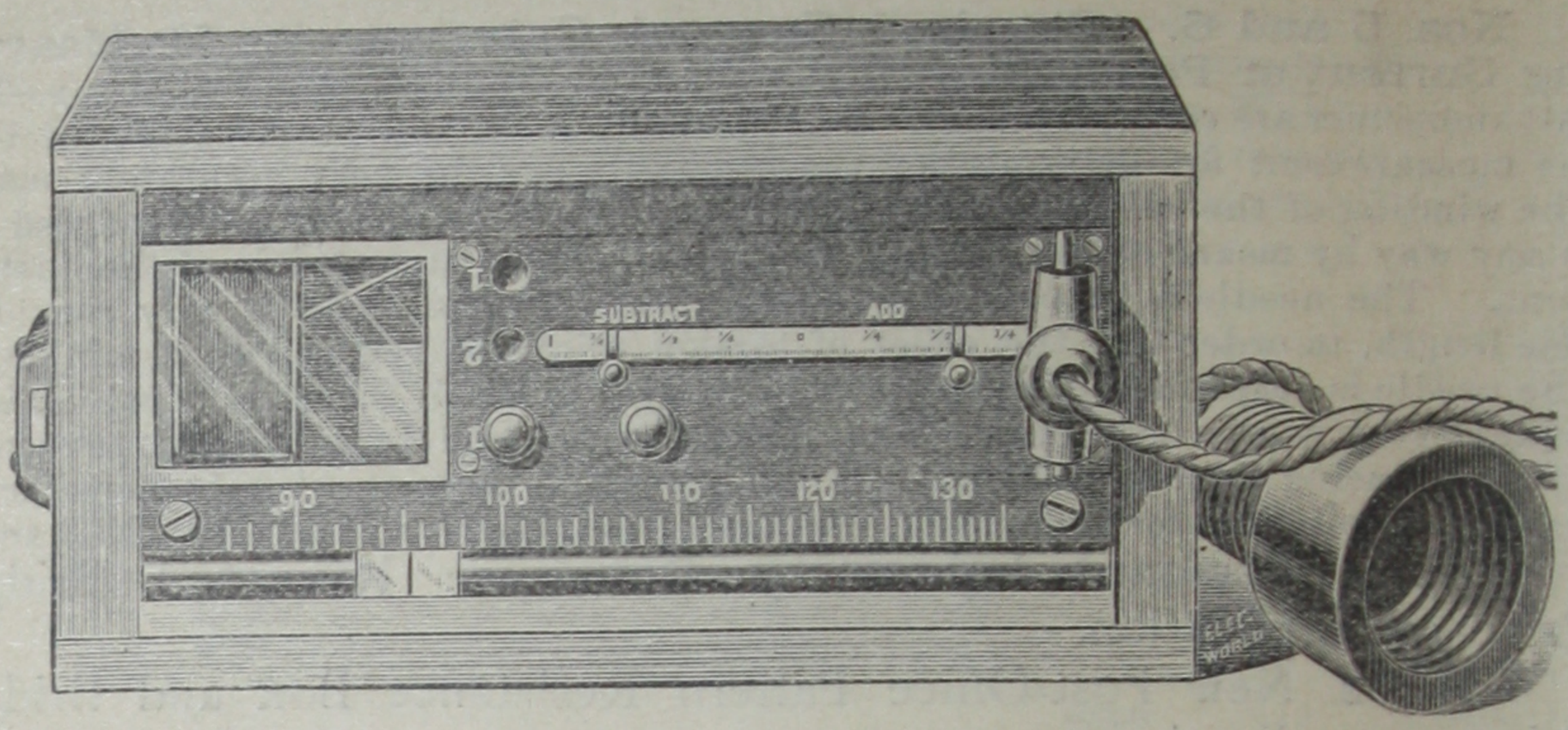
We are now entering quite largely into the manufacture of Electrical Test Instruments, having arranged for the sole right of manufacturing the instruments designed by Prof. W. A. Anthony, as well as having gotten out a number of valuable designs of our own. The finer instruments, such as Resistance Coils, etc., will all be tested by Prof. Anthony, and a certificate, signed by him, furnished as to their accuracy.

The high reputation of this well known electrician, combined with our excellence of manufacture, are guarantees of the quality and accuracy of the instruments we propose to furnish.

Latimer Clark Standard Cells.

Since the classical experiments of Lord Raileigh's, a good many attempts have been made to construct a portable form of the Latimer Clark Standard Cell. Aided by the advice of eminent scientists, and by our own practical experience in the matter, we are prepared to furnish a standard of Electromotive Force equal to 1.435 Volt at 15° C, in a very convenient form. There can be no injury to this new cell from transportation since the mechanical details of effective sealing are perfect, and the amount of mercury used is made a mininum. The cell will not dry out and keep a constant E. M. F. for years, if not short circuited. To prevent the latter, a high resistance can be furnished with the cell.

Price of each Cell in brass case, - - - -	$10.00
Set of three Cells, - - - - - -	25.00



The Howell Voltmeter.

The Howell Voltmeter is a Portable, high resistance potentiometer having two Latimer Clark cells as standards of comparison. These cells are hermetically sealed and are enclosed within the instrument, concealed from view. Each of these cells is a check upon the other, and their perfect agreement insures the accuracy of the instrument.

The cells are guaranteed to last one year if used properly. We will replace free of charge any cell that fails within one year, if printed directions are followed.

The scale of this voltmeter may be verified by anyone, at any time, by a Wheatstone's bridge, and the known E. M. F. of a Latimer Clark cell which is 1,435 at 15° C.

This Voltmeter requires very little skill in using, and may be left in circuit any length of time, always giving correct readings.

This instrument will be found extremely convenient for inspectors of electric light plants, since it combines with its compactness a very high degree of accuracy.

These voltmeters are made for any pressures from 1½ volts up to 1,500 volts, the one most in demand reads from 40 to 160 volts. Voltmeters of any other capacity made as ordered.

Price for pressures below 250 volts, $60. A smaller size, made to be carried in the hip-pocket, $75.

JAMES W. QUEEN & CO.,

MANUFACTURING ELECTRICIANS,

924 Chestnut Street,

Address Dept. 4
Physics and Chemistry.

PHILADELPHIA, U. S. A.

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